Entropia: Building an Internet-scale Computational Grid

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NASA IPG Meeting, Mt View, California

Sept 19-20, 2000

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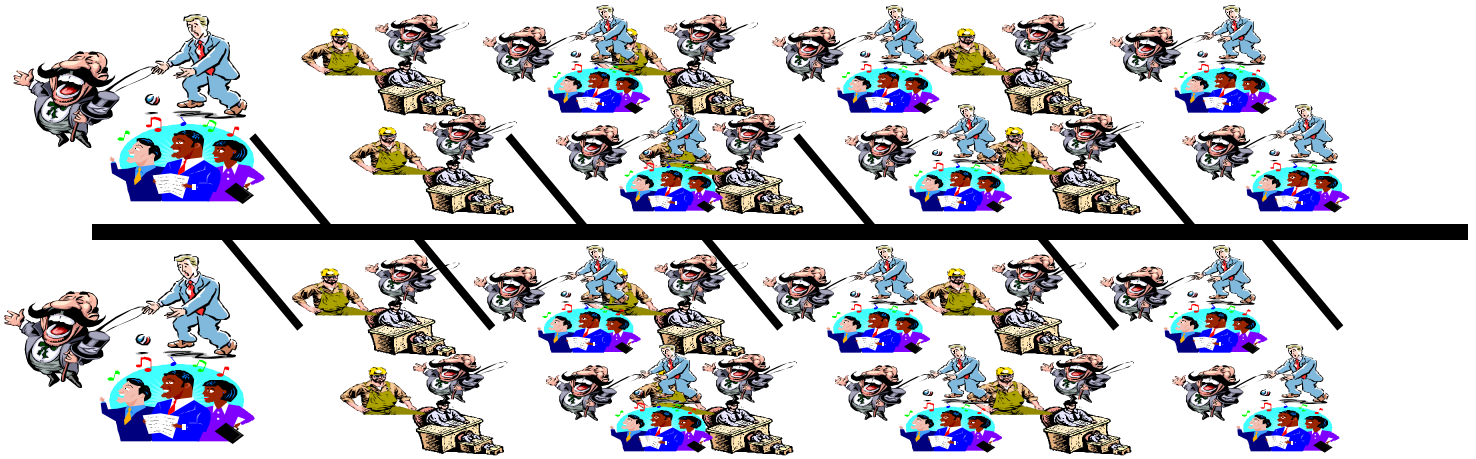
Internet Computing



- Idea: Assemble large numbers of idle PC's in people's homes, offices, into a massive computational resource
  - Enabled by broadband connections, fast microprocessors, huge PC volumes
  - 300M PC's today, number increasing rapidly

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Internet Computing Context

- Explosive growth in
  - PC power (processor, memory, disk)
  - Broadband connectivity (to home, in workplace)
  - Peer to Peer: desktop power >> server power
- By 2002, 10 Million Processors will be
  - 10 Petaflop (10,000 Teraflop) or…
    - 10x IBM Blue Gene, three years sooner
    - 1000x IBM's ASCI White (today's fastest supercomputer)
  - 1 Exabyte (million terabytes) ~ total Y2000 industry output

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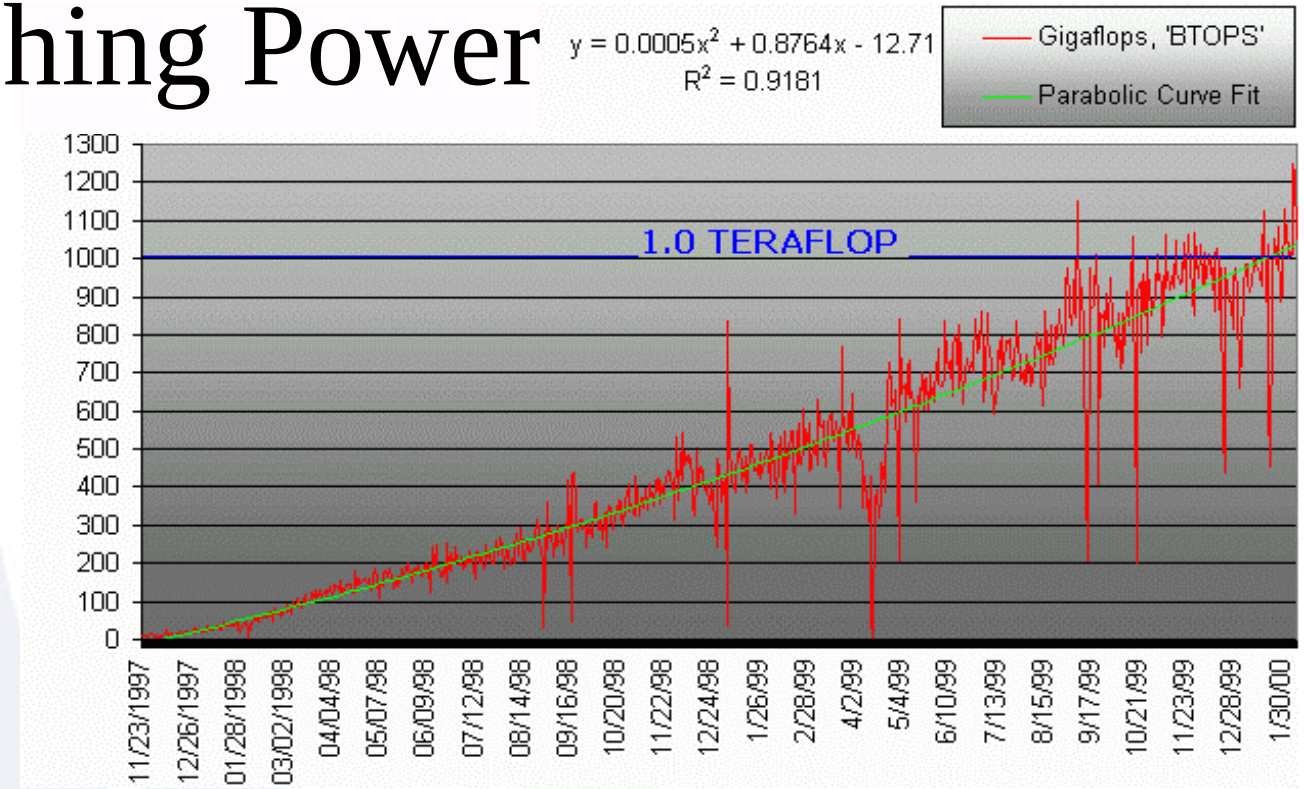
Astonishing Power



- Entropia network: ~30,000 machines (and growing fast!)
  - 100,000, 1Ghz => 100 TeraOp system
  - 1,000,000, 1Ghz => 1,000 TeraOp system (1 PetaOp)

Why now?

Computing Supply

- 500+ MHz desktop computers are high capability resources
- Maturation of large-scale distributed computing technologies

Network Connectivity

- Widespread deployment of broadband connections from homes and offices to the Internet

Computing Demand

- New applications require massive computing: drug & gene research, digital imaging, software & chip verification, financial services, product design
- Maturation of the users, computational applications and data sets

Brief History of Entropia

- 1997 Year of the Prototype
  - Business objectives established, first customer identified
  - Prototyping, development and testing Entropia1
- 1998 Year of the Proof of Concept
  - First customer's research on Entropia1 (first discovery made)
  - Demonstrated technology, operations and recruiting at scale
- 1999 Year of the TeraFlop
  - Entropia1 sustains over 1 teraflop (10^{12})
  - Peer-reviewed and published customer (2 million digit prime discovered)
  - SETI @ Home announced
- 2000 Year of Commercialization
  - January: Entropia1 exceeds 100K PCs in over 80 countries
  - February: Series A funded by Institutional Investors
  - August: Commercial Entropia 2000 deployed
  - September: Major new applications announced

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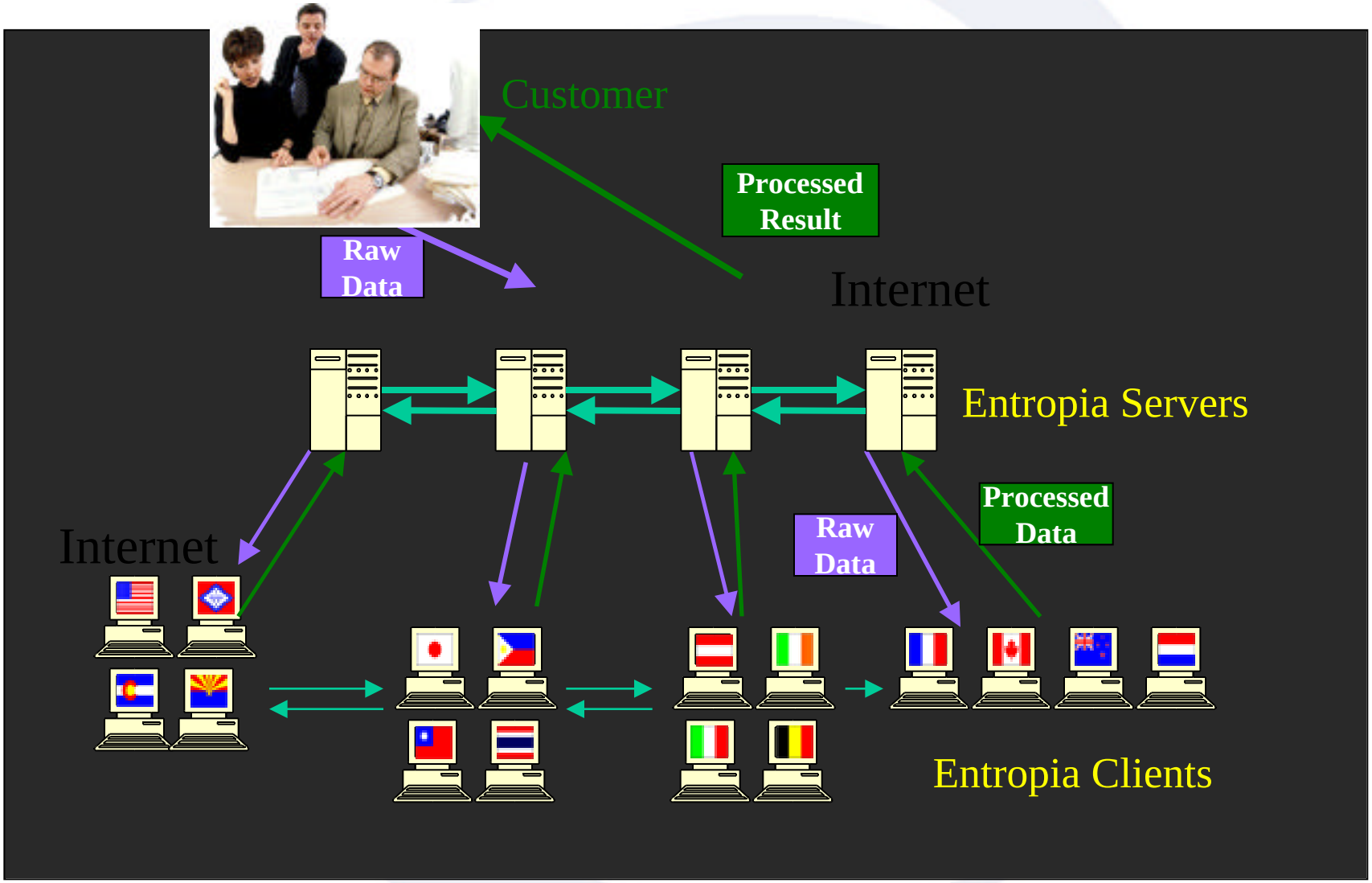
Entropia Distributed Computing



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Internet Computing Evolution

- Today: Single-application networks
  - SETI @ Home, Distributed.net, Entropia1
- Future: increasing generality
  - Multiple-application networks
    - Large applications, significant integration effort
  - General purpose platform
    - Smaller applications, lower integration effort, many more applications
- Increasing trust and dependence on these capabilities

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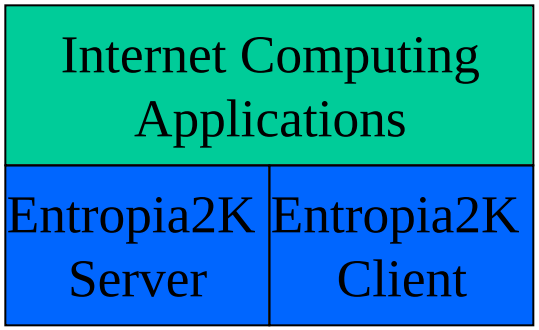
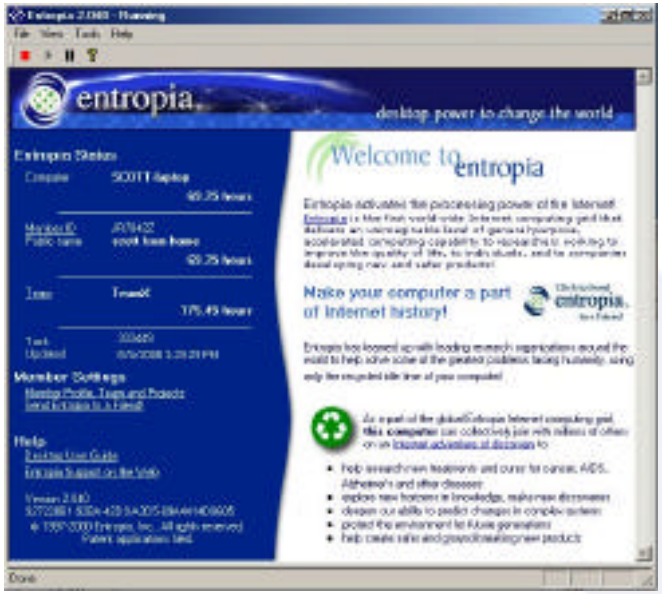
Entropia 2000 Internet Computing Platform





- Enables Scalable Multiple-application Internet Computing
  - Lightweight Internet Computing API
  - Entropia 2000 Platform Services
    - Dynamic scheduling
    - Application executable and data staging
    - Network and ISP environments, even disconnected execution
- Supports Membership Growth
  - Dynamic GUI and Work Progress Indicator
  - Link to Web site team and project statistics
  - Application preference, intrusiveness control (cpu, network, disk usage)

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Why Participate: Cause Computing!

Mathematical Research

Push the limits of our theoretical understanding of the abstract mathematics tools that civilization is built upon and explore these new frontiers with your computer.

Fighting Diseases

Striving to improve quality of life and eliminate suffering, Entropia members can support disease research projects.

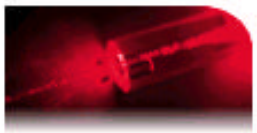
Entertainment

Entropia is building new technologies to help accelerate wonderful new digital entertainment productions. Your computer can be a key part of bringing this exciting new technology to life!

Economics Research

Long term stability of the world economies has become crucial to growing prosperity. Entropia members can help illuminate the meanings of global economic behavior through rigorous research models.

Scientific Research



Science is a foundation on which many of the greatest human achievements rest. The Entropia community can participate in some of the most intense scientific research underway today.

Environmental Research

Responsible management and preservation of Earth's environment requires a deep understanding of the complex effects of many factors. Entropia members can help researchers determine the most important aspects of planet stewardship for future generations.

Product Design

Researching safe product designs quickly and effectively requires an ever increasing amount of computing power to test and refine them before manufacturing even begins. Your computer can play a crucial role in making safer medicines, transportation, appliances, clothing, toys and more!

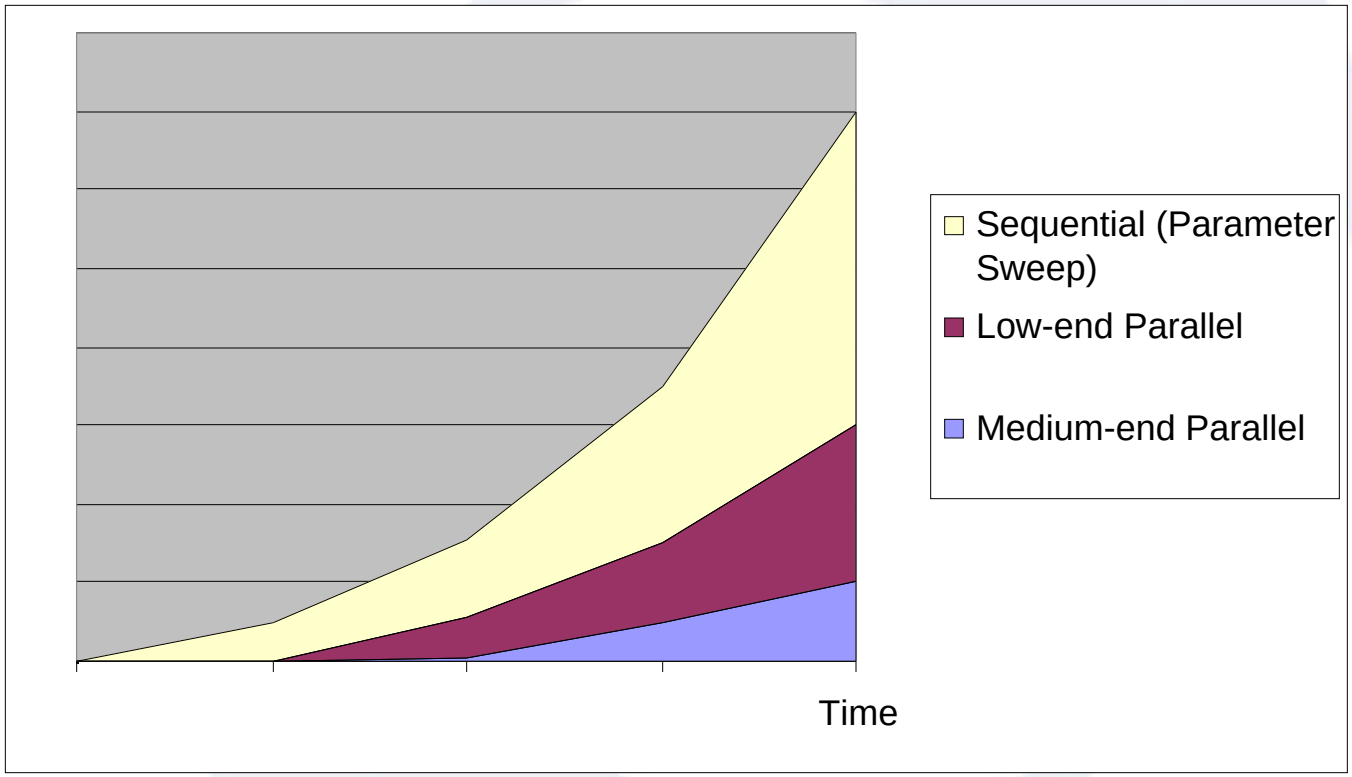
People *Do* Contribute

- Millions have demonstrated willingness to donate their idle cycles
- "Great Cause" Computing
  - Current: Find ET, Large Primes, Crack DES…
  - Next: find cure for cancer, muscular dystrophy, air and water pollution, …
    - understand human genome, ecology, fundamental properties of matter, economy
- Participate in science, medical research, promoting ideas that you care about

Significant Technical Challenges

- Security and Protection: machines, programs, data
- Extremely heterogeneous systems and complex network environments
- Scalability, Reliability, and Robustness of Network
- Scalable, reliable, robust Applications
- Low effort application migration

Application Types



- Support single- to multi-processor applications as infrastructure supports intense communication
- Transitions tied to physical infrastructure – type acquired and evolution

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Entropia Senior Team

- CEO: Jim Madsen (MIT BS, Stanford GSB)
  - 12 years leadership in wireless: QUALCOMM, NextWave
  - Technology Business Development, Sales and Marketing

- Co-founder & CTO: Dr. Andrew Chien (MIT BS, MS, Ph.D.)
  - UCSD SAIC Chair Professor of Computer Science & Eng'g
  - international leader in scalable commodity PC clusters, distributed computing, parallel computing, and object-oriented programming

- Founder and VP Biz Dev: Scott Kurowski
  - established the Entropia Vision and Mission, developed its business model and created the Entropia network

- CFO: Michael Shneyderman (Stanford GSB)
  - Managing Director Siguler, Guff LLC, American Express, Wells Fargo, Berkeley International Capital Corporation

- VP Marketing, Membership & Communications:
  Neville Billimoria (UCSD)
  - 10+ years as President of software & marketing communications firms for biotech

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Technical Capabilities

Strong and Deep (~40 fte's)

–Including 10+ PhD's in CS + (Physics, Chemistry, ChemE, Bio,...)

- Dr. Steve Elbert
  - former Program Manager for NSF Supercomputing Centers
- Dr. Brad Calder
  - UCSD Professor, world expert in binary modification, compiler and computer architecture. Founder Tracepoint.
- Dr. Maya Natarajan
  - Expert in genomics & bioinformatics. 5 patents. Isis business development.
- Xiaosheng Tu
  - MS Computer Science & MS Molecular Biology. 5 years at Incyte in Bioinformatics
- Cristos Goodrow
  - MS Mathematics. Senior Software architect including Tealeaf Technology, Impresse Corporation, Peoplesoft,and Anderson Consulting.
- Dr. Kang Su Gatlin
  - PhD dissertation in high performance computing, best paper at SuperComputing'99
- Steven Pujia
  - Extensive experience with 3D modeling software (3D Studio MAX, Alias/Wavefront Technologies), complex real-time physics modeling

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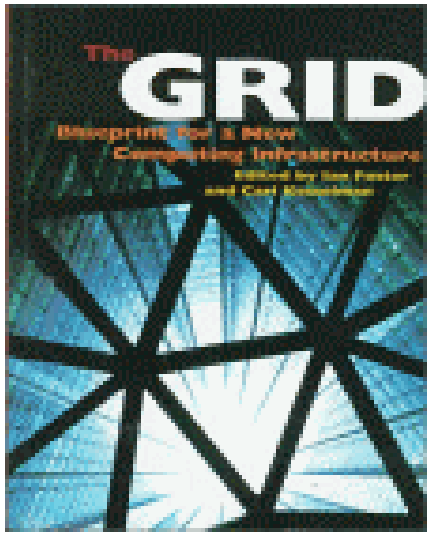
Stellar Scientific Advisory Board

- Dr. Larry Smarr, supercomputer expert and former director of NCSA (mosaic)

- Drs. Carl Kesselman & Ian Foster, authors/editors of *The Grid: Blueprint for a new computing infrastructure*, the industry 'bible'

- Dr. Forest Baskett, fmr. CTO of SGI; built original O/S for Cray-1. Partner, New Enterprise Associates



- Dr. Stephen Crocker, Internet pioneer and security expert. CEO Longitude Systems

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Summary

- Internet computing systems are Computational Grids
  - Radical technical challenges
  - Vast and profound opportunities
- Join the Adventure at Entropia
  - http://www.entropia.com/join.asp

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